

---

## Care of War Veterans with Mild Traumatic Brain Injury — Flawed Perspectives

Charles W. Hoge, M.D., Herb M. Goldberg, B.A., B.Ed., and Carl A. Castro, Ph.D.

Researchers estimate that more than 300,000 U.S. veterans of the wars in Iraq and Afghanistan (20% of the 1.6 million) have sustained a mild traumatic brain injury (TBI), also known as concussion, with the majority going untreated.<sup>1</sup> In response, the Department of Defense and the Department of Veterans Affairs (VA) have implemented new postdeployment health initiatives, including screening, communication strategies, disability regulations, and specialty care services.

Unfortunately, the clinical definition of “concussion/mild TBI” adopted by the Department of

Defense and the VA — a blow or jolt to the head resulting in brief alteration in consciousness, loss of consciousness (lasting less than 30 minutes), or post-traumatic amnesia — is inadequate for achieving the objectives of these well-intentioned initiatives. The case definition lacks three essential criteria for use months after injury: symptoms, time course, and impairment. It pertains only to physiological disruption of brain function at the time of injury. Health initiatives crafted through consensus processes using this definition are likely to be causing unintended consequences.

To identify those who sustained a concussion/mild TBI during deployment, the postdeployment screening form asks service members and veterans to recall whether they were “dazed” or “confused” at the time of an injury or blast “experience.” Positive responses to this single unvalidated question have accounted for two-thirds of all reported cases of concussion/mild TBI. The remaining cases are clinically similar to sports concussions, involving brief loss of consciousness (usually lasting seconds to a few minutes) or post-traumatic amnesia.<sup>2,3</sup> Arguments that cli-

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>APR 2009</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-2009 to 00-00-2009</b>	
4. TITLE AND SUBTITLE <b>Care of War Veterans with Mild Traumatic Brain Injury - Flawed Perspectives</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Walter Reed Army Institute of Research, Division of Psychiatry and Neuroscience, Silver Spring, MD, 20910</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	18. NUMBER OF PAGES <b>4</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

nicians can reasonably confirm distant concussion/mild TBIs<sup>2</sup> are unfounded, because an alteration of consciousness in combat may also result from normal responses to injury, acute stress, dissociation, sleep deprivation, syncope, or the confusion of war.

The goal of postdeployment screening is to identify and treat service members and veterans with persistent postconcussive physical, neurocognitive, and behavioral symptoms (e.g., headache, sleep disturbance, irritability, dizziness, imbalance, fatigue, inattention, and problems with concentration or memory). However, without symptoms or a time course in the definition, clinicians' attribution of such non-specific symptoms to concussion/mild TBI is subjective.

Postdeployment screening is founded on the assumption that a causal connection has been established between concussion/mild TBI and persistent postconcussive symptoms. Regardless of the etiology of these symptoms, the structure of the screening questionnaires — which combine questions concerning the case definition and symptoms — produces a foregone conclusion that these variables are causally related. One study reported an odds ratio for this association, violating the statistical principle of independence of variables.<sup>2</sup> The screening process has led to reports that 40% of service members who have had concussions experience one or more persistent symptoms<sup>2</sup> — much higher than the 3 to 5% rate expected on the basis of studies in civilians.<sup>4</sup>

Proponents of these screening procedures argue that trained clinicians can discern the cause

of symptoms.<sup>2</sup> Yet, clinicians have no validated diagnostic criteria. Substantial evidence demonstrates the difficulty of attributing symptoms to mild TBI, suggesting that clinical interviews will result in erroneous conclusions. Studies have shown high rates of symptoms in healthy populations, poor validation of postconcussion syndrome case definitions, and a prevalence of postconcussion-like symptoms after non-head injuries that is similar to the prevalence after mild TBIs.<sup>4</sup> The relationship between the number of concussions sustained and outcomes has not consistently demonstrated a dose response. Psychological factors, compensation and litigation, and patients' expectations are strong predictors of the persistence of symptoms.<sup>4</sup> In veterans of the Iraq war, postconcussive symptoms have been more strongly correlated with post-traumatic stress disorder (PTSD) and depression than with concussion.<sup>3</sup> (Information on additional reference materials can be found in the Supplementary Appendix, available with the full text of this article at NEJM.org.)

Concussion is associated with axonal stretching, swelling, and metabolic changes that may result in secondary disconnection.<sup>4</sup> However, the threshold and determinants of clinically meaningful neurophysiological disruption and recovery are ill defined. Studies have been hampered by inadequate control groups and an overrepresentation of samples from emergency departments and hospitals. Promising neuroimaging techniques, such as diffusion tensor imaging, currently have limited clinical usefulness.

A 2008 Institute of Medicine report on the long-term consequences of TBI, commissioned by the VA, concluded that there was "inadequate/insufficient" evidence that "mild TBI" causes neurocognitive deficits or adverse social and occupational functioning but "sufficient" evidence that "TBI" is associated with postconcussive symptoms. Unfortunately, the latter conclusion is uninterpretable because concussion was not distinguished from moderate and severe TBI.

Postdeployment screening is administered within a structure of care encompassing communication, treatment, and disability initiatives — influenced by definitional issues — all of which are likely to promote negative expectations for recovery. Multiple studies have shown that expectations exert a powerful effect on the persistence of symptoms after concussion.<sup>4</sup>

Widespread use of the terms "mild TBI," "signature injury," "invisible wound," and "silent epidemic," as well as patient-education materials that combine mild TBI with more serious types of TBI, are examples of poor risk communication. "Mild TBI" is often misused to refer to postconcussive symptoms, conveying a present-tense state of an incompletely healed brain injury (brain "damage"), whereas "concussion" refers to a past event, consistent with its definition. Since the wars in Iraq and Afghanistan began, approximately 1000 service members have been treated for moderate or severe TBI, although 300,000 are publicly reported as having "TBI."<sup>1</sup> A RAND Corporation report, biased by a lack of population-based data, illogically

suggested that a concussion, which usually resolves rapidly (within hours to days), costs more in 1 year than a case of PTSD or depression, including suicide, costs in 2 years.<sup>1</sup> Attribution theories involving blast also fuel negative expectations. One of the most widely cited studies purporting to show a relationship between primary blast exposure and postconcussive symptoms failed to define concussion.<sup>5</sup>

Lacking an accepted medical definition for postconcussive symptoms or impairment, the VA created a disability category called

“residuals of TBI.” The 2008 federal regulation creating the category assigns a 40% disability to persons who have three or more subjective symptoms that “moderately” interfere with functioning or who have “objective evidence” of “mild impairment of memory, attention, concentration, or executive functioning resulting in mild functional impairment.” The regulation ignores extensive literature demonstrating the strong association between compensation and persistence of symptoms after concussion.

Service members and veterans

with suspected postconcussive symptoms are referred to specialty TBI or polytrauma clinics designed for moderate and severe TBI — contrary to evidence-based best practices centered in primary care that were established after the first Gulf War for the treatment of postwar symptoms. The treatment of symptoms such as headaches, irritability, or sleep problems does not vary according to the presence or absence of a history of mild TBI. Cognitive or multidisciplinary rehabilitation designed for moderate and severe TBI has not been effective

Comparison of Mild TBI with Moderate and Severe TBI.*		
Variable	Mild TBI (Concussion)	Moderate and Severe TBI
Clinical definition	Loss of consciousness lasting <30 min, any alteration in consciousness, or post-traumatic amnesia lasting <24 hr; some definitions include Glasgow Coma Scale score of 13 to 15	Loss of consciousness lasting ≥30 min up to prolonged coma, post-traumatic amnesia lasting ≥24 hr up to permanently, or Glasgow Coma Scale score as low as 3
Focal neurologic signs	Usually none or transient	Frequently present
Neuroimaging with CT or MRI	Usually negative	Diagnostic
Natural history	Full recovery is usual; there is lack of consensus on the natural history of concussion and postconcussive symptoms	Natural history and recovery are directly related to the severity of injury and functional neuroanatomy
Case definitions and specificity of injury sequelae	Case definitions of postconcussion syndrome have low reliability and validity and show poor correlation with one another; there are high rates of these symptoms in healthy populations and high rates of “postconcussion syndrome” after non-head injuries	Injury sequelae are not debated
Predictors of persistent symptoms or disability	Psychological factors (e.g., depression, anxiety, or PTSD), compensation and litigation, and negative expectations and beliefs are the strongest risk factors	Directly related to injury characteristics
Neurocognitive testing	Often inconclusive beyond the period of acute injury	Essential and valuable component of ongoing clinical care
Neuronal-cell damage	Metabolic and ionic processes caused by axonal twisting or stretching; these can lead to secondary disconnection	Combination of cellular disruption directly related to injury and metabolic, vascular, and ionic processes
Epidemiologic evidence of causation between injury and sequelae	Inconsistent and debated	Not debated

\* CT denotes computed tomography, MRI magnetic resonance imaging, PTSD post-traumatic stress disorder, and TBI traumatic brain injury.

for mild TBI. The perspective that mild TBI is part of a medical continuum with moderate and severe TBI guides interventions, despite strong evidence that they are distinct clinically and epidemiologically (see table).<sup>4</sup>

Debate over the nature of postconcussive symptoms and their relationship to PTSD clouds treatment strategies. Postconcussive symptoms, not the mild TBI itself, overlap with numerous illnesses, including postwar health conditions that have been described for centuries. The current emphasis on attributing postwar “postconcussive” symptoms to one of two potentially stigmatizing diagnoses — mild TBI or PTSD — reflects a lack of understanding that the strategies most likely to be effective are evidence-based treatments for functional somatic symptoms.

The consequences of misattributing symptoms include side effects of medications and inappropriate treatment, including a failure to address underlying conditions (e.g., depression, PTSD, or substance abuse), the use of unproven rehabilitation procedures, and the prescribing of medications for nonapproved indications (e.g., an atypical antipsychotic for sleep). Unproductive and time-consuming tests, including neurocognitive assessments, may reinforce patients’ negative perceptions of illness.

The care of veterans who have any war-related injury or health

concern is of the highest priority. Devoting increasingly more personnel and time to the illusory demands of mild TBI could hinder service members’ and veterans’ recovery. Interventions based on flawed definitions and perspectives have resulted in unintended consequences that reinforce the perceived necessity for the interventions, producing a self-fulfilling prophecy.

On the basis of this analysis, a different public health approach is recommended. This approach would establish case definitions and evaluation tools that fulfill criteria for causation, have clinical validity, and do not lead to misattribution; ensure that screening does not include nonspecific questions, is conducted near the time of injury, and maintains the independence of variables; use communication strategies that promote expectations of recovery — replacing the term “mild TBI” with “concussion” at least for cases involving low risk (e.g., loss of consciousness lasting less than 5 minutes or amnesia lasting less than 30 minutes); apply knowledge from studies on the relationship between compensation and persistent postconcussive symptoms to ensure that disability regulations do not generate disability; concentrate resources on a comprehensive structure of care for all deployment-related health concerns, including postconcussive symptoms, that is centered in primary care and con-

forms to evidence-based step-care and collaborative-care models; and reduce the impact of flawed assumptions, conformity to consensus processes, and lack of scientific rigor on health policies and outcomes.

The goal of these objectives is to enhance patients’ expectations of recovery, reduce the severity of symptoms, prevent long-term disability, and provide optimal care for service members and veterans returning from war.

No potential conflict of interest relevant to this article was reported.

The views expressed are those of the authors and do not represent the official policy or position of the U.S. Army or the Department of Defense.

Dr. Hoge is the director of the Division of Psychiatry and Neuroscience and Mr. Goldberg is chief of risk communication and quality assurance in the Battlemind Training Office, at the Walter Reed Army Institute of Research, Silver Spring, MD. Dr. Castro is the director of the Military Operational Medicine Research Program, U.S. Army Medical Research and Materiel Command, Fort Detrick, MD.

1. Tanielian T, Jaycox LH, eds. *Invisible wounds of war: psychological and cognitive injuries, their consequences, and services to assist recovery*. Santa Monica, CA: RAND, 2008.
2. Terrio H, Brenner LA, Ivins BJ, et al. Traumatic brain injury screening: preliminary findings in a US Army Brigade Combat Team. *J Head Trauma Rehabil* 2009;24:14-23.
3. Hoge CW, McGurk D, Thomas JL, Cox AL, Engel CC, Castro CA. Mild traumatic brain injury in U.S. soldiers returning from Iraq. *N Engl J Med* 2008;358:453-63.
4. McCrea MA. *Mild traumatic brain injury and postconcussion syndrome: the new evidence base for diagnosis and treatment*. New York: Oxford University Press, 2008.
5. Cernak I, Savic J, Ignjatovic D, Jevtic M. Blast injury from explosive munitions. *J Trauma* 1999;47:96-103.

Copyright © 2009 Massachusetts Medical Society.